A Preliminary Study of Portunid Crabs in Biscayne Bay

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Portunid crabs (Crustacea, Portunidae) are important as predators and scavengers and as sea-food, but their ecology is not well known. The present study treats the populations of different species in Biscayne Bay, Florida, a tropical estuary, and their relationships to the substratum. Many studies have been made on the ecology of the blue crab, *Callinectes sapidus*, in temperate estuaries. Darnell (1959) has summarized these and has provided an excellent bibliography.

The physical environmental variables in Biscayne Bay are well known (e.g., Hela et al., 1957; McNulty et al., 1962; and Smith et al., 1950), and much of the fauna and flora has been studied (e.g., Pearson, 1936; O'Gower and Wacasey, 1967; and Voss and Voss, 1955). However, of the fourteen species included in this study only five have been previously recorded from Biscayne Bay.

The main area of this study is the central portion of Biscayne Bay (i.e., Rickenbacker Causeway Island, Virginia Key, Key Biscayne, and adjacent areas on the mainland). Collections were made on sand, mud, gravel, and grass communities. The grass beds (marine angiosperms) are primarily *Thalassia testudinum* but *Syringodium filiforme*, and *Diplanthera wrightii* are also often present. Beds of primarily *Syringodium* or *Diplanthera* were not sampled, except for sand communities with very light, sparse, growths of *Diplanthera*. Although no collections were made on rocky bottoms, species from such communities are included in the discussion.

This area is south of the twenty degree celsius minimum marine isotherm (Fuglister, 1947), and therefore the fauna and flora are basically tropical.

Methods

A collection was made at each of twenty locations over an eight month period, from July 1967 to February 1968 using a hand-pulled, rectangular dredge with a one by one-half meter opening with nylon netting of three-eighths inch stretched mesh. The locations were as follows: (1) S.E. Bear Cut (SS); (2) Cape Florida Marina (T/S); (3) Matheson Hammock (HS); (4) S.W. Bear Cut

(HS); (5) S.W. Virginia Key (D&S); (6) S. Rickenbacker Causeway Island (D&S); (7) N. Virginia Key (D&S); (8) S.E. Bear Cut (T/S); (9) Matheson Hammock (T/S); (10) N.W. Bear Cut (A&G); (11) S.W. Bear Cut (T&G); (12) N.E. Virginia Key (T/S); (13) N.E. Virginia Key (HS); (14) N.E. Key Biscayne (SS); (15) S.E. Bear Cut (T/S); (16) N.W. Virginia Key (HM); (17) S.E. Bear Cut (SS); (18) W. Key Biscayne (T/M); (19) W. Key Biscayne (SM); (20) Matheson Hammock (HS).

"*Thalassia* over sand" (T/S) and "*Thalassia* over mud" (T/M) refer to grass beds. "*Thalassia* and gravel" (T&G), "algae and gravel" (A&G), and "*Diplanthera* and sand" (D&S) refer to areas with very light, broken, growths of marine plants, which are primarily sand or gravel communities. "Hard sand" (HS) and "hard mud" (HM) are areas where the substratum is hard-packed. Areas of loose, soft bottom are referred to as "soft sand" (SS) or "soft sandy mud" (SM).

Each collection was a sample of approximately 400 square meters. All crabs were preserved in 10 per cent formalin. The carapace width for each crab was measured to the nearest millimeter. Identifications were made after Rathbun (1930), and Williams (1965 and 1966). Substratum and water samples were collected for each location. The water temperature and salinity were recorded. The substratum samples were individually wet sifted through a series of geological sieves of sizes 841, 595, 177, 125, and 74 microns, and particles smaller than 74 microns were collected on no. 1 filter paper. These samples were also analyzed for the organic content using hydrogen peroxide to oxidize the organics.

List of Species

Arenaeus cribrarius. Although this species was not found in this study, it has been recorded in Biscayne Bay by Rathbun (1930). Dr. Martin Rossler (personal communication) has stated that they are at least seasonally common in Norris Cut (between Virginia Key and Fisher's Island).

Callinectes danae. A total of seven specimens were caught at locations 1, 4, 8, 14, and 15. Crabs on sand averaged 40 mm (carapace width) and those on grass averaged 89 mm with the net average 61 mm. This species was only found on, or adjacent to, the ocean side of the islands. From the occurrence records in

Rathbun (1930), it appears that this species is usually found on wave beaten sandy shores and has not been recorded from the Florida Keys. Their occurrence may be related to the loose, wave beaten, quartz sand which is not found within Biscayne Bay or in the Florida Keys where the quartz sand is replaced by calcium sand, gravel, and rocks. This may also be the reason for the similar distribution of *Arenaeus cribrarius*.

Callinectes exasperatus. Only two specimens, both females, (54 and 117 mm) were found in this study, both at location 2. This species has never been recorded north of the Florida Keys (Rathbun, 1930).

Callinectes ornatus. A total of 415 crabs of this species were caught and represented an average population density of 9.7/100 m^2. The average carapace width was 37 mm. This is the most abundant portunid in Biscayne Bay, found at all locations except location 16 where no crabs were found. The average population densities (crabs/100 m^2) were; on soft sand, 22.5; on *Thalassia*, 6.3; on hard sand, 4.7; and on *Diplanthera* and sand, 2.7. The average sizes were; on *Thalassia*, 47 mm; on *Diplanthera* and sand, 38 mm; on soft sand, 36 mm; and on hard sand, 33 mm. For population densities greater than 7/100 m^2, the population densities were directly proportional to the average carapace widths (a correlation co-efficient of $r = 0.9$ was found). Approximately eleven per cent of the total population was visibly infected by the sacculinid parasite *Loxothylacus texanus*.

Callinectes sapidus. A total of 18 crabs of this species were caught at locations 5 and 9, with single specimens from locations 1 and 3. The average carapace width was 81 mm and the average population density 2/100 m^2. This species is most abundant in the canals and areas of very low salinity which were not included in this study. The subspecies *Callinectes sapidus acutidens* represents part of the population in Biscayne Bay. Approximately 22 per cent of the population in Biscayne Bay was visibly infected by the sacculinid parasite *Loxothylacus texanus*. Breeding appears to occur in early January (report of crab fishermen) and September (egg bearing females caught) in Biscayne Bay. In Alligator Harbor, west Florida, *C. sapidus* breeds in late February, early March, late April, and early September (Wass, 1955). *Callinectes sapidus* breeds in March, April, and September in Aransas

ay, Texas (Daughtery, 1952). Considering the marine isotherms in Fuglister (1947), these findings agree well with others (Darnell, 1959) which have found breeding to be dependent upon temperature in temperate areas.

Cronius ruber. Although this species was not found in this study, specimens from Biscayne Bay are in the museum of the Institute of Marine Sciences. Most of the specimens listed by Rathbun (1930) are from rocky or coral bottoms. This may explain why *Cronius ruber* was not found in this study.

Cronius tumidulus. A total of 46 crabs of this species were caught at locations 1, 4, 8, 14, and 15. These represented an average population density of 2.5/100 m^2. The average carapace width was 24 mm. In Rathbun (1930) *Cronius tumidulus* was only listed from "seagrass", in this study it was only found in *Thalassia* beds. Except for location 15, the following relationships appear to hold: The population densities appeared to be inversely proportional to the average carapace widths. Also the average sizes appeared to be directly proportional organic content of the substratum. On 30 December 1967 (location 14) and 6 January 1968 (location 15) females bearing bright red eggs were caught. Location 15 showed a population density twice that usually observed for this species, and most of the crabs caught were egg-bearing females. This suggests a breeding migration.

Luppela forceps. Only a single specimen, an immature female of 24 mm was caught (location 1). Since this is a common offshore species, the single specimen is probably a stray.

Ovalipes quadalupensis. Although this species was not caught during this study, one specimen was reported by Mr. E. T. LaRow (personal communication) from Bache Shoal, off Sands Key, adjacent to Biscayne Bay, in February 1968. This species has not been previously recorded so far south (Rathbun, 1930; Williams, 1965).

Portunus depressifrons. A total of 246 crabs of this species was caught at locations 1, 2, 6, 7, 8, 10, 11, 12, 14, 15, 17, 19, and 20. The average population density was 6.7/100 m^2 and the average size 18 mm. This is the second most abundant portunid in Biscayne Bay, found in all areas except those of hard packed bottom or areas in which *C. sapidus* was found. Those on sand averaged 16 mm and those on *Thalassia* 23 mm. Even though this is a very common species, it has not been previously recorded in Biscayne

Bay. The wide range of habitats in which this species was found agrees well with the wide range of habitats listed by Rathbun (1930).

Portunus gibbesii. Twelve specimens were caught at location 10 and single specimens were taken at locations 11 and 14. The average population density was 4.9/100 m^2 and the average carapace width 27 mm. Location 10, the only area with a large population, was unique in that the substratum particles were very large; particles greater than 841 microns 27 per cent (versus an average for all other locations of 6 per cent); greater than 595 microns 53 per cent (average 9 per cent); greater than 177 microns 100 per cent (average 64 per cent); smaller than 125 microns 0 per cent (average 12 per cent); smaller than 74 microns 0 per cent (average 5 per cent). The organic content of the substratum at location 10 could not be detected (i.e. less than 0.2 per cent, the average for the other locations was 1.8 per cent). This type of substratum is characteristic of the cuts and channels of this area. This species has not been previously recorded from Biscayne Bay.

Portunus ordwayi. Although only one specimen of 42 mm was caught at location 2, a number of specimens from Biscayne Bay are in the museum of the Institute of Marine Sciences, and this species has been recorded in Biscayne Bay by Rathbun (1930) and by O'Gower and Wacasey (1967).

Portunus sayi. Although this species was not obtained in the present study, I have previously found a number of specimens in floating *Sargassum* and a few in grass beds. This species is a member of the floating *Sargassum* community and is washed ashore with the algae. Apparently it cannot survive for long without *Sargassum.* One of the specimens taken was carrying a sacculinid parasite.

Portunus sebae. Although this species was not found during this study, a number of specimens from Biscayne Bay are in the museum of the Institute of Marine Sciences. Rathbun (1930) has recorded this species from the Florida Keys, mostly from rocky bottom. I have also collected a number of specimens from hard coral bottom at Key Largo. Apparently this species prefers rocky bottom. This would explain why none were caught in the present study.

Portunus spinimanus. A total of 17 crabs of this species were caught at locations 6, 7, 10, 11, 14, and 15. The average population density was 1.2/100 m^2 and the average carapace width was 26 mm. This species was only found on open sand which had a light covering of *Diplanthera* or algae. Rathbun (1930) did not record any specimens from grass beds.

Discussion

In the 6574 square meters sampled, 756 crabs were caught representing a net average population density of 12.1 crabs per 100 square meters.

Callinectes ornatus, Callinectes sapidus, Portunus depressifrons, P. gibbesii, P. spinimanus, and *Cronius tumidulus* have large populations in Biscayne Bay. *Callinectes ornatus* is the most abundant with *P. depressifrons* second. Both were found on sand, mud, grass, and gravel. The other species were more limited with *C. sapidus* in areas of low salinity, *Cronius tumidulus* on grass, *P. gibbesii* on gravel, and *P. spinimanus* on sand. No portunids, other than *C. ornatus* were found with *C. sapidus,* perhaps because of competition and/or predation by *C. sapidus.*

A number of species are only occasionally found and possibly represent migrated populations. These include *Callinectes danae, P. ordwayi,* and *Callinectes exasperatus.* Although not found in this study, specimens of *P. sebae, Arenaeus cribrarius,* and *Cronius ruber* from Biscayne Bay are in the museum of the Institute of Marine Sciences. *Portunus sayi* and *Lupella forceps* are only present as strays. *Callinectes marginatus, P. spinicarpus, P. ventralis,* and *Ovalipes quadalupensis* have ranges which extend at least near Biscayne Bay (Rathbun, 1930).

Provenzano (1961) has recorded the South American *Callinectes bocourti* from Biscayne Bay from a single specimen which is very similar to the *Callinectes exasperatus* of this area.

Attempts to introduce the tropical Pacific portunid *Scylla serrata* have been made, but have been discontinued. None were caught during this study, nor, to the best of my knowledge, have they been recovered by anyone.

Callinectes similis, a species only recently (Williams, 1966) distinguished from *C. ornatus* and *C. danae,* was not found during this study.

Specimens labeled *Portunus bahamensis* from Biscayne Bay are in the museum of the Institute of Marine Sciences. However, I feel that these specimens are actually *P. depressifrons*. They differ from the description of *P. depressifrons* by Rathbun (1930) only as to the shape of the orbital and the size of the lateral teeth, thus approaching *P. bahamensis*. Furthermore many specimens were caught which were intermediate between the two extremes.

Rathbun (1930) has recorded *P. ordwayi*, *C. sapidus*, *C. ornatus*, and *Arenaeus cribrarius* from Biscayne Bay. *Portunus ordwayi*, and *Cronius tumidulus* have been recorded by O'Gower and Wacasey (1967) and *C. sapidus* and *C. ornatus* by Voss and Voss (1955).

The average total population densities were the greatest on soft mud (70.5 crabs/100 m^2), soft sand (24.6), and gravel (24.5). The population densities were the least on hard packed sand (5.6), *Diplanthera* and sand (4.8) and on hard mud (0.0). *Thalassia* beds appear to support intermediate population densities (*Thalassia* on sand, 11.5 and *Thalassia* on mud, 8.6). However, the average carapace widths of crabs on *Thalassia* are the greatest (e.g., for *C. ornatus* the average carapace width on *Thalassia* was 47 mm versus an average for all of the other areas of 30 mm).

The average salinity during this study was 33.6 ppt and the average temperature was 26.0 degrees Celsius. These are very similar to the findings of Smith et al. (1950).

Substratum particle size distribution did not appear to be a major factor in the distribution of any of the portunids in Biscayne Bay, except for *P. gibbesii*. Substratum particle size distribution does not necessarily characterize the substratum as soft or hard, or sandy or muddy. Softness, hardness, sandiness, muddiness, and the extent of cover by grasses appear to be the most significant factors affecting the distribution of the crabs. The organic content of the substratum was also important for some species.

Wass (1955) has made a general study of the crustaceans in the vicinity of Alligator Harbor on the west coast of Florida. He found *Ovalipes quadulupensis*, *Araneaus cribrarius*, *C. danae*, *C. sapidus*, *P. depressifrons*, *P. gibbesii* and *P. spinimanus* present. The latter four of these are common in Biscayne Bay. The former three occur in Biscayne Bay in small numbers, probably seasonally. Competition by these three may have replaced *C. ornatus* in that area.

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